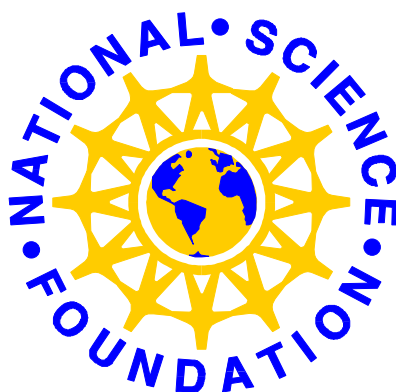


Large Facility Projects Management & Oversight Plan



September 10, 2001

I. INTRODUCTION

Throughout its history, the National Science Foundation (NSF) has enjoyed a successful track record of providing state-of-the-art facilities for science and engineering research and education. NSF management and oversight have enabled not only the establishment of these unique national assets, but have also ensured that they continue to serve the science and engineering communities they are intended to benefit.

NSF has enabled the construction of unique telescopes and managed their operation by funding nongovernmental institutions created for that purpose. For decades, the University National Oceanographic Laboratory System of research ships has been effectively conducting multidisciplinary research and education in the remotest regions of the Earth. The Deep Sea Drilling Project and its successors have operated with an exemplary record of scientific discovery and effective contractual management. NSF has managed the U.S. Antarctic Program since 1960, and since the early 1970s it has been responsible for the planning and budgeting of all logistical support and facilities construction for the U. S. program in Antarctica. In addition, NSF has enabled major advances in building and managing large-scale computational infrastructure supporting virtually all fields of science and engineering.

NSF's approach to facilities management differs from many R&D agencies in that NSF does not directly construct or operate the facilities that it supports. Typically, the NSF makes awards to external entities, primarily to universities and non-profit organizations, to undertake construction, management and operation of facility projects. NSF enters into partnerships with these organizations, with the terms of the partnerships most often defined in cooperative agreements.¹ NSF retains responsibility for overseeing the management and successful performance of these projects. NSF decision-making not only involves establishing new facilities but also reconstituting or phasing out support for facilities that have reached the end of their useful lives or have not met the high standards set by NSF.

Currently, NSF invests over \$1 billion annually in facilities and other infrastructure projects. Over time, the portfolio of facilities has grown and diversified to include distributed projects that challenge traditional management and oversight approaches. Emerging multidisciplinary science and engineering opportunities have resulted in NSF moving towards a greater number of large facility projects that are increasingly complex and present challenging technical and management issues. Growth and diversification require that NSF remain attentive to the ever-changing issues and challenges inherent in planning, construction, operation, management and oversight of large facility projects. As NSF's portfolio has evolved, so too have its management and oversight practices. Given the increasing complexity and scope of its facilities, NSF recognizes the need to mitigate attendant risks by ensuring that management and oversight benefit from contemporary best practices. Improving coordination, collaboration and learning among NSF staff and external partners will facilitate incorporation of best practices. Complying with instructions in *A Blueprint for New Beginnings: A Responsible Budget for America's Priorities* (February 2001),² NSF developed the Large Facility Projects Management and Oversight Plan presented here.

The Plan outlines NSF's goals and strategies for integrating its current procedures and processes into a next-generation system for selecting, managing and overseeing large facility projects. The system is designed to ensure not only that a large facility is "built right" but also that it is the right facility to build. In this Plan, NSF addresses four critical areas:

¹ These partnerships have generally proven to be remarkably effective in terms of both overall cost and performance. An essential added benefit of NSF's model is the opportunity to train tomorrow's scientists and engineers by allowing them direct involvement in planning, construction and operation of major facilities and large-scale instrumentation.

² The *Blueprint* states, "NSF is managing several multi-year, *large facility projects*. NSF's capability to manage proposed projects needs to be enhanced given the magnitude and costs of these projects. NSF will develop a plan to enhance its capability to estimate costs and provide oversight of project development and construction. This plan should help ensure that NSF is able to meet and stick to cost and schedule commitments for major facility projects."

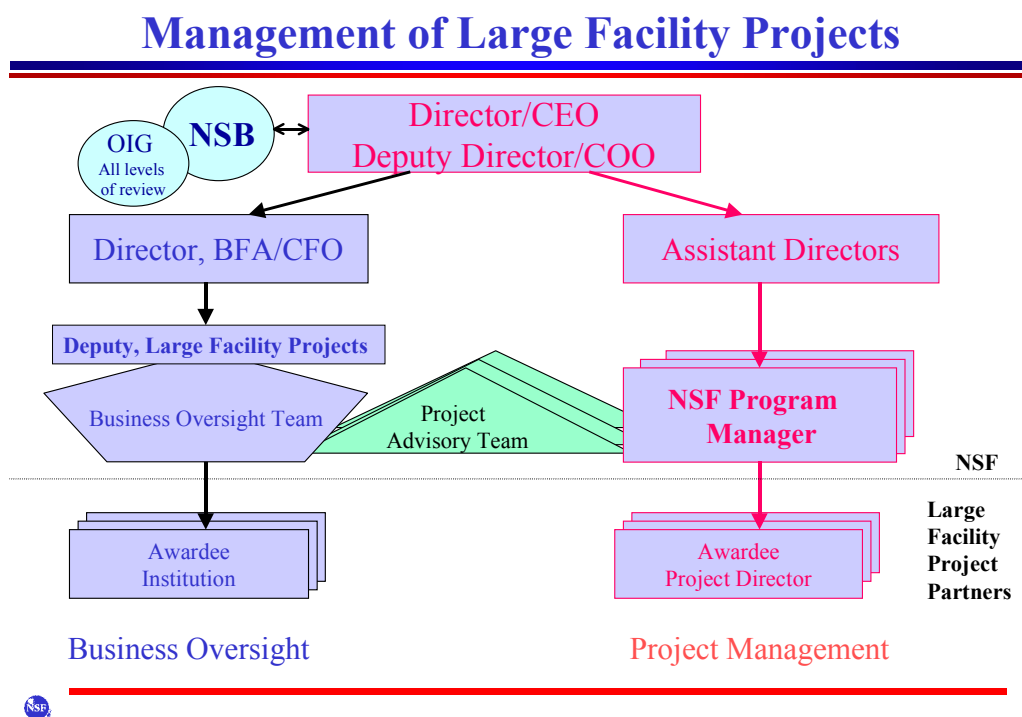
- Organizational and staff capabilities and coordination, collaboration, and shared learning among NSF staff and external partners (Section III),
- Comprehensive guidelines and procedures for all aspects of facilities planning, management and oversight (Section IV),
- Review and approval of large facility projects (Section V), and
- Coordinated and proactive oversight of all facility projects (Section VI).

II. DEFINITION OF A LARGE FACILITY PROJECT

To implement its strategic plan,³ NSF invests in “People, Ideas, and Tools.” NSF’s investment in Tools, the “broadly accessible, state-of-the-art shared research and education infrastructure,” is intended to enable discovery at the frontiers of science and engineering and enhance the productivity, effectiveness and renewal of the science and engineering workforce. For purposes of this document, “large facility projects” refers to the subset of awards made by NSF (within the Tools category) for the purpose of establishing and/or operating a major tool or facility that will enable a community of researchers and/or educators. Such a tool must be either: (1) centralized in nature or (2) an integrated system of leading-edge instruments and/or information that serves as a shared-use networked facility.⁴ A large facility project is further defined as having a total cost on the order of projects historically funded through the Major Research Equipment (MRE) account.⁵ Large facility projects may be funded through either the MRE, the Research & Related Activities (R&RA), and/or the Education and Human Resources (EHR) accounts.

III. ORGANIZATIONAL AND STAFF CAPABILITIES

The figure below illustrates the approach NSF takes to manage and oversee large facility projects.



³ NSF’s Strategic Plan can be found at <http://www.nsf.gov>.

⁴ Infrastructure includes acquisition and/or construction and subsequent operation. It also includes hardware and software design, purchase and installation, as well as the network and connections that integrate the system.

It depicts a team-oriented approach, with scientific and technical staff working hand-in-hand with business operations staff. The figure depicts clear lines of authority, responsibility and communication from the NSF Director, the cognizant Assistant Director and the NSF Program Manager to the awardee Project Director. In every large facility project, the NSF Program Manager, supported by the cognizant Division Director and Assistant Director, exercises primary responsibility for all aspects of project management. The NSF Program Manager will have the requisite training, skills and experience to successfully manage the project. Working closely with the NSF Program Manager, the awardee⁶ designates one person – with strong management experience – to be the awardee Project Director, with overall control and responsibility for the project in the awardee organization. The NSF Program Manager is responsible for ensuring that the awardee Project Director and project management staff have the requisite training, skills and experience to perform the project to stated goals.

NSF vests responsibility for monitoring business operations of large facility projects in the Director, Office of Budget, Finance and Award Management, who is also the Chief Financial Officer (CFO). NSF personnel reporting to the Director, BFA/CFO ensure that all policies, guidelines and procedures are followed and that the awardee is in compliance with business operations, legal and financial requirements.

Through the Project Advisory Teams (PATs), individuals from the project management and business oversight staffs work together. For every large facility project, the NSF Program Manager will convene a PAT (a practice required for all MRE projects) to provide advice and assistance on planning, review and management of the project to assure the establishment of realistic cost, schedule and performance goals and to develop terms and conditions of awards for constructing, acquiring and/or operating the facility. Each PAT will be comprised of professionals with critical expertise in the relevant science and engineering fields, as well as management, business and legal aspects associated with the project.

To enable the efficient and effective evolution of NSF's large facility projects from their pre-formulation through operations, NSF will establish a new position, **Deputy, Large Facility Projects**. The LFP Deputy will report directly to the Director, BFA/CFO. Through a nationwide search, NSF will recruit an individual with extensive project management experience, including building, management and oversight of large scientific and engineering facilities. The LFP Deputy will be responsible for:

- Providing expert assistance to NSF's science and engineering staff on non-scientific/technical aspects of project planning, budgeting, implementation and management;
- Developing, implementing and managing, with NSF-wide input and concurrence, management and oversight policies, guidelines and procedures; and,
- Ensuring shared learning of best practices by fostering coordination and collaboration throughout NSF to facilitate application of lessons learned from each project.

The LFP Deputy will be supported by several permanent NSF staff with a mix of skills, qualifications and extensive experience in project management, planning and budgeting, cost analysis and oversight. These personnel will represent a centralized resource to assist (but not supplant) NSF Program Managers with management and oversight responsibilities and to develop and conduct comprehensive post-award oversight of business operations, financial and internal control systems, and cost and schedule performance. They and experts from other NSF Divisions and Offices (e.g., Office of General Counsel; Budget Division; Division of Contracts, Policy and Oversight; and Division of Grants and Agreements) will form the LFP Business Oversight Team. This flexible, responsive team will work with NSF Program Managers to ensure that awardees are

⁵ The MRE account is an agency-wide capital asset account that funds the establishment of major S&E infrastructure, with costs ranging from several tens to hundreds of millions of dollars.

⁶ For projects that are implemented through multiple awards, the NSF Program Manager will ensure that one of the awardees has the capability and resources necessary to take responsibility for the overall management and successful performance of the project.

performing to the terms and conditions of their awards and that they are attaining cost and schedule goals. The project management staff and the business oversight staff are each responsible for informing the other of performance issues that arise within their respective spheres and to work together to solve these problems. They are also each responsible for informing higher management levels of significant issues and problems. Issues that cannot be resolved at these levels will be referred through the chain of command to the Deputy Director, who is also the Chief Operating Officer, for resolution.

The LFP Deputy, the Business Oversight Team, the NSF Program Manager and the Project Advisory Team will facilitate interactions and learning across projects and, in so doing, will institutionalize a process for large facility projects oversight. To ensure that project and business teams contain the skill mix essential for success of large facility projects, NSF will draw upon its new Administration & Management plan both to provide comprehensive training and to recruit additional personnel, as needs arise.

IV. GUIDELINES AND PROCEDURES

Drawing upon the wealth of experience within NSF and in NSF's external partners, the guidelines in place for MRE projects will be enhanced for applicability to all large facility projects.⁷ NSF is already working on this and will host a "best practices" workshop in September 2001 to ensure a well-informed base for developing these comprehensive guidelines. NSF Program Managers, awardee Project Directors, facilities users and experts from other Federal agencies have been invited to make presentations and will explore the range of planning, budgeting, management and oversight practices and techniques currently employed.

Once the guidelines have been established, its principles will be followed in developing operational procedures. Together, the guidelines and procedures will provide pre-decisional and post-award guidance to NSF Program Managers and their PATs. They will also form the basis for a Large Facility Projects Manual that will convey NSF's expectations for sound project management and will serve as the standard reference for facility management and oversight.

NSF develops and supports a broad continuum of facilities, not all of which warrant the same degree of planning, budgeting, review and approval scrutiny. They all, however, warrant a level of management and oversight commensurate with their complexity and risk. The guidelines will ensure that all NSF-supported facilities are guided by a common set of principles while also addressing the special considerations associated with support of large facility projects.

V. REVIEW AND APPROVAL PROCESS

Large facility projects advance through several phases as they mature from pre-formulation to operation. Appendix 1 provides a chart describing the review, approval, implementation and operation lifecycle for large facility projects. The chart describes in detail the roles of various stakeholder groups during a project's lifecycle. Appendix 2 describes NSF's current process for the review and approval of large facility projects considered for funding through the MRE account.

NSF is developing comprehensive guidelines and procedures that will require every large facility project proposal submitted to NSF to contain a management plan that covers all phases of the project, including planning, budgeting, construction or acquisition, integration and testing, commissioning, operations and maintenance. They will specifically address the qualifications and capabilities of the awardee to successfully manage and implement the project. These plans, which are already required for projects considered for funding through the MRE account, will be reviewed by NSF before awards are made.

The criteria NSF uses to select large facility projects for inclusion in a budget request and to determine which projects it will fund will be clearly articulated and available to NSF's stakeholders. These criteria are listed

⁷ *Guidelines for Planning and Managing the Major Research Equipment Account*, which provide the basis for budgeting for MRE facilities, can be found at <http://www.nsf.gov/home/about/mre01.html>.

below. The first two are the general NSF merit review criteria used in the merit review process. The next six are additional criteria that NSF and National Science Board (NSB) use to review and approve projects for inclusion in a budget request. This process is described in detail in Appendices 1 (Lifecycle of Large Facility Projects) and 2 (MRE Review and Approval Cycle).

- ❑ **Intellectual Merit**
- ❑ **Broader Impacts**
- ❑ Importance to science and engineering
- ❑ Cost-benefit and risk analysis
- ❑ Readiness to implement and manage
- ❑ Appropriateness for NSF
- ❑ Balance across fields and disciplines
- ❑ Synergy with other large facilities supported by NSF, other agencies, and other nations

VI. PROJECT OVERSIGHT

NSF is developing and will introduce a systematic and consistently applied program of oversight for all facility projects. Building on current best practices, NSF will accomplish this through timely assessment of awardee capability, review of awardee performance, and early identification of problems and solutions. Initially, and periodically throughout the life of a facility,⁸ the LFP Deputy, the NSF Program Manager and the Business Oversight Team will conduct oversight reviews. The LFP Deputy will develop a model template for the reviews, which can be adapted to specific facilities. Business oversight staff will assess awardee capabilities and performance (i.e., business processes, financial and internal control systems, and project management), while the NSF Program Manager will assess programmatic and technical capabilities and performance.

These reviews are intended to provide an “early warning signal” into NSF’s oversight system so that potential problems, and solutions, are identified early. In-depth review and discussion with the awardee on all aspects of capabilities and performance will enhance facility management.

The LFP Deputy will be responsible for analyzing results of oversight reviews in order to identify issues and solutions that affect one or more facilities. When this occurs, the LFP Deputy will ensure that changes are made to guidelines and procedures and training materials, and that relevant staff throughout NSF are advised so that all processes can be improved. The lessons learned as a result of the reviews will feed into all areas of NSF responsible for facilities, allowing best practices to be readily and uniformly shared.

VII. IMPLEMENTATION

As evident from its track record, NSF recognizes the importance of continuous improvement of its systems for selecting, managing and overseeing its large facility projects and has devised an aggressive schedule for developing and implementing each of the major components of an improved system, aspects of which are already in progress. Milestones for the major focus areas of NSF’s Plan are presented below.

| | |
|-------------------|--|
| <u>Sept. 2001</u> | <i>Large Facility Projects Management and Oversight Plan</i> submitted to OMB Initiate nationwide search for LFP Deputy |
| <u>Jan. 2002</u> | Develop comprehensive guidelines Begin project oversight reviews |
| <u>Feb. 2002</u> | Develop Large Facility Projects Manual |

⁸ Awardees are visited early in the award process, and then on a regular basis. The frequency of these visits will be determined following a risk assessment and analysis that takes into consideration the nature of the facility, its complexity, and the dollars and time involved. As reviews are conducted and completed, the lessons learned will be applied to adjust the intervals.

Lifecycle of Large Facility Projects

| | Pre-Formulation | Formulation | Award | Implementation | Operation |
|---|--|--|---|---|--|
| | Concept development; early definition and planning | Project design & definition; technical & management plans | RFPs, Program Solicitations, MOUs; Award Instruments | Construction; acquisition; installation; commissioning | Operations; maintenance and repair; upgrade; research; decommissioning |
| S&E Community | Participates in workshops, committees, studies, and other vetting processes | Vetting of project design and definition in relevant S&E communities | Participates in external peer review | Vetting of plans to operate and manage the project or facility | Participates in review and oversight (e.g. site review teams); facility users |
| External Partners (Potential Awardees) | May discuss concept with NSF or submit unsolicited proposal | Develops design, definition and plans; may submit/modify proposals to NSF | Develops project plans; may submit/modify proposals to NSF | Manages all aspects of project implementation; reports to NSF as required | Manages & monitors all aspects of operation; reports to NSF as required. |
| NSF Originating Organization/NSF Program Manager | Initial discussions with potential external partners; internal & external vetting; reviews unsolicited proposals | Convenes Project Advisory Team; approves project definition; proposes project to MRE Panel | Where applicable, develops Program Solicitations/RFPs & merit reviews proposals; helps develop award instruments; recommends awards; provides project funding | Oversees implementation; monitors performance; reviews & approves all changes | Project management & oversight; site visits; approves project reports/changes |
| LFP Deputy | Provides early advice and assistance to NSF Program Manager on project management | Analyzes project; advises NSF Program Manager on non-technical aspects of management & oversight | Develops protocols for pre- and post-award management and oversight reviews | Teams with NSF Program Manager to conduct oversight reviews; provides early warning of potential problems | Assists NSF Program Manager as required |
| Business Oversight Team | Assists NSF Program Manager with planning and budgeting | Early budget and non-technical reviews | Where applicable, helps develop, review, approve Program Solicitations/RFPs; develops award instruments | Reviews/approves changes to award instruments (e.g. cost, schedule & project scope) | General oversight and monitoring; participates in management and oversight reviews |
| MRE Panel (if applicable project) | Initial review of projects for inclusion in the MRE visionary pipeline list | Reviews and recommends projects to NSF Director for inclusion in budget request | Reviews, approves Project Management Plan | Reviews/approves changes to management plan; reviews project status | Regularly reviews status of all projects |
| Director's Review Board⁹ | Reviews projects going to NSB as information items | Reviews and approves MRE projects & other submissions to NSB | Reviews release of applicable RFPs; reviews recommended awards | Reviews projects going to NSB as action and information items | Reviews projects going to NSB as action and information items |
| National Science Board | NSB (CPP) reviews visionary pipeline projects | Approves applicable facility projects for inclusion in budget request | Approves applicable RFPs and awards (See PAM) | Reviews status of projects; approves applicable awards | Reviews status of projects; approves applicable awards |
| NSF Director | Reviews/discusses visionary pipeline projects with OMB and NSB (CPP) | Selects projects for inclusion in a particular budget request | Approves/signs MOUs; approves/allocates funding | Reviews status of projects; approves annual budget requests; allocates funding | Reviews project status reports; approves annual budget requests; allocates funding |

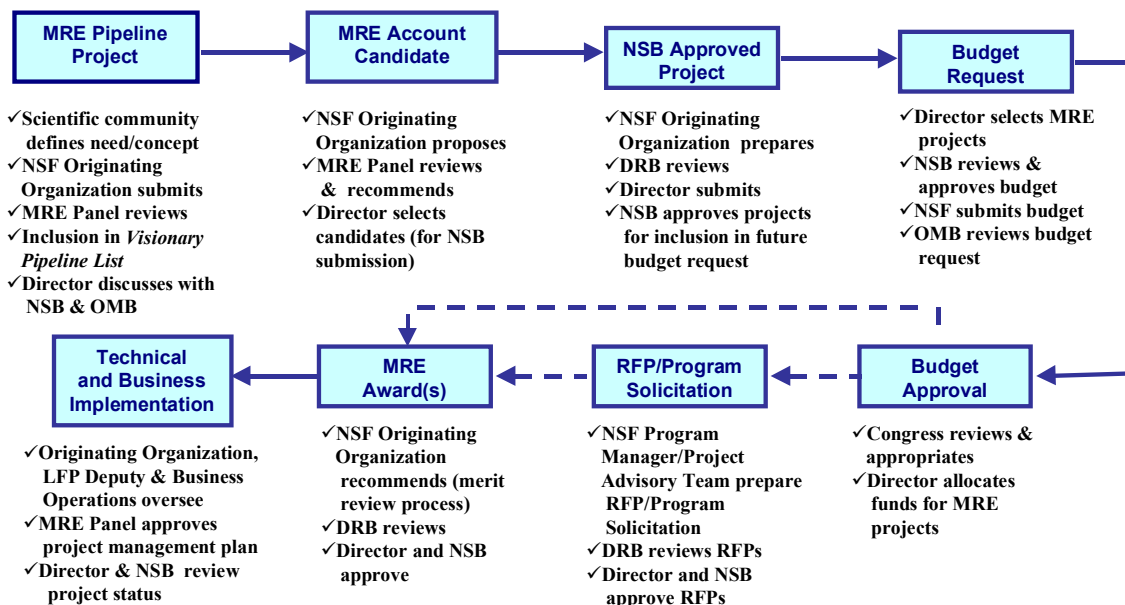
This chart provides a detailed overview of each of the entities involved in each of the phases of a large facility project. During **Pre-Formulation**, an NSF Program Manager works with the scientific and engineering communities to develop a shared understanding of the potential large facility project concept and requirements and to identify schedule and performance issues.

⁹ The Director's Review Board (DRB) reviews large NSF awards. It is chaired by the Deputy Director/COO and comprises NSF senior line managers.

At the **Formulation** stage, the NSF Program Manager, in consultation with potential awardees, the scientific and engineering communities and the PAT, refines project design and definition, scientific/technical and management plans. The Business Oversight Team, led by the LFP Deputy, assists the NSF Program Manager with development and review of budget and other non-technical documents. In the **Award** phase the NSF Program Manager prepares the funding recommendation which is reviewed at the appropriate levels. Following review and approval, an award is made. The project moves then into the **Implementation** (construction or acquisition, integration, testing and commissioning) phase and continues into the **Operations** phase. Throughout each phase, the NSF Program Manager and associated PAT, along with the LFP Deputy and the Business Oversight Team, conduct appropriate levels of project oversight. Results of these oversight activities are widely disseminated where appropriate to ensure that NSF management and NSF stakeholders are fully informed of project status and performance.

Appendix 2

MRE Review and Approval Cycle



This chart describes NSF's process for the review and approval of large facility projects considered for funding through the MRE account. The first step in the process is the early identification of an MRE Pipeline Project as such. These potential projects are conceived of in the science and engineering community, often as a result of emerging science and engineering opportunities, and are often many years in development following initial conceptualization.

An NSF Originating Organization(s) then proposes developed projects for consideration by the MRE Panel. These projects may be based on a proposal already submitted and evaluated using NSF's merit review process. The MRE Panel considers the projects on the basis of the review criteria specified earlier and makes recommendations to the Director. Using the review criteria, the Director selects candidates for NSB consideration. The NSB then approves, or not, projects for inclusion in future budget requests. The Director then selects from the group of NSB-approved projects those appropriate for inclusion in a budget request to OMB, and after discussion with OMB, to the Congress.

Following the appropriations process, the Director allocates funds to the relevant projects. If necessary, a program solicitation or RFP is prepared and, following receipt and merit review of the proposals, one or more awards are made. Elements of the process depicted in this chart are described in detail in Appendix 1.